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USAGE OF FILLER TILE OR MARUTHY TILE IN AND AS A PART OF CONCRETE

Safasanah[1,] Abdul Rahman[1], Aftab Usman[1], Mazher Fuad[1], Mohammed Nidal[1]

[1]Department of Civil Engineering, P. A. College of Engineering, Mangaluru, Karnataka, India.

*Corresponding Author: Safasanah C. Email: safa.civil@pace.edu.in

Abstract:

Innovative and reasonably priced filler slab technology reduces the encumbrance of a slab by partially replacing the concrete with filler material. It describes the usage of filler tiles as a fundamental component of concrete slabs and their advantages and disadvantages. Filler slabs are added to concrete slabs to improve structural performance, aesthetic appeal and sustainability, among other benefits. Concrete slabs potential as a versatile building material can be fully realized by incorporate filler tiles into them.

This study examines the number of filler tile usage related topics - such as, appropriate tile type selection, Installation methods, and the effect of filler tile qualities on slab characteristics. This project aims to estimate amount of concrete and steel saved as a result of usage of filler in the RCC slab, study the structural behavior of the filler slab, and to compare the heat insulation properties of filler slab with conventional RCC.

According to the study's findings, filler tiles help the concrete slabs load bearing capacity,minimize its risk of crackingand improve the durability. Additionally infill tiles can improve the slab's aesthetic appeal by enabling customized designs and patterns.By minimizing the waste and utilizing the recycled or re purposed materials,the usage of filler tiles also encourages sustainable practices.

Overall this research highlights the significance of using filler tiles as a practical way to improve structural performance, aesthetics, and sustainability in building projects.

Keywords:

Filler slab, RCC, structural performance, sustainability load bearing capacity, durability, heat insulation property, customized designs and patterns.

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1. Introduction

Innovative and reasonably priced filler slab technology reduces the encumbrance of a slab by partially replacing the concrete with filler material. Since all the concrete in the tension zone does not contribute to the tensile qualities, the idea behind the usage of filler-slab technology is to eliminate a sizeable amount of that concrete. Without sacrificing the quality and structural integrity of the construction, this concrete is replaced with a lightweight, inert, and affordable filler [1]. The filler slab is based on the concrete portions and instead of placing filler material there and is one of the most cost-effective roofing system present in the current scenario. It is one of the ancient time technologies which saves labor and material cost to a large extend. Due to the use of low-cost, less-heavy filler materials such as clay pots, and broken pieces of cement blocks, the filler slab consumes less concrete and steel as compared to the conventional RCC slab [2]. The replacement of inoperable cement concrete with lighter filler materials, encumbrance of the slab is diminished considerably. The reduction in weight as much as 20 to 30% enhances thermal comfort inside the building due to heat-resistant caliber of filler materials and the gap between two burnt clay tiles. A technique to reload the concrete in the tension zone is the filler slab [3].

As a result, the filler material is not a structural component of the slab. The cost of the roof is decreased in such a way that along with maintaining the strength of the customary slab by decreasing the quantity and weight of the material. The roofing tile is one of the popular filler materials. The building uses less cement and steel and is a good heat insulator in comparison. As long as using the filler slab is concerned the critical zone does not uplift the tensile properties but it increases the concentration of concrete below the neutral axis. Without compromising the structure's quality or structural integrity, this concrete is replaced with a lightweight, affordable, inert filler.

Cost lucrativeness is one important aspect because it costs less than the cost of the concrete being replaced.

Panchal and Marathe [1] For a G+30 storied commercial project that is constructed in an earthquake zone, they weigh the advantages and drawbacks of steel, steel concrete composite, and R.C.C. options. The experimental work-up indicates that the ecumbrance of a steel-framed structure is reduced by thirty two percentage when compared to a R.C.C. frame structure, and that of a composite-framed structure is reduced by thirty percentage when compared to a R.C.C. frame structure. Shear forces in secondary beams are typically increased in steel structures by

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83.3% and decreased in composite structures by 10% when compared to R.C.C. framed structures, while shear forces in main beams are typically increased in steel structures by 131% and decreased in composite structures by 100%.

Suryawanshi [2] the study surrounded near the nodal displacement in a particular steel structure. The study summarized that the nodal displacements in steel composite structures using both seismic analysis methods are lower than those in R.C.C. structures in all three global directions. Renavikar [3] by including an analogous R.C.C structure the experiments compared the cost of steel concrete composite and equivalent R.C.C structure. The RCC and steel-concrete composite of various mentioned story structures such as (G+9, G+12, G+15, G+18) that are located in Pune's earthquake zone III and have a 43 m/s wind speed were compared in this study. The study employed the Equivalent Static Method for analysis.

Shweta, Waghe [4] Using the ETABS 2013 software, four different multi-story commercial buildings (G+12, G+16, G+20, and G+24) were examined. By using MS-Excel programming for design and cost estimation, a comparison between R.C.C. and composite structures is made based on the results. The composite structure was found to be roughly twice as strong as the R.C.C. structure, yet within acceptable limits. When compared to composite structures, R.C.C. structures have higher shear and axial forces.

Umesh and Suryanarayana [5] a comparison of the G+ 15-storey RCC and composite structures was observed and compared in the experimental study. The Software which was designed for this purpose was ETABS 2013. In a zone three earthquake zone of medium soil both the RCC and composite structure have swampy storey at the ground level. The Analysis was made using the equivalent static and response spectrum approach. The criteria taken into consideration are storey drift, self-weight, bending moment, and shear force. Finally after the whole experiment it was concluded that when compared to RCC, composite structure performed better.It was determined that the storey drift in soft storey levels is 10% less in composite models than in RCC. Storey drift is reduced by 70% in other storeys that use a similar static situation. Murat and Bünyamin [6] in this research, both parametric studies and actual buildings were used to examine the effect of solid and lightweight hollow block slabs on construction costs. A solid slab in concrete structure can be described as the one in which a typical slab is supported by beams and columns and has loads are transferred to them. Solid slab systems are known to modify structural ductility and affect the findings of modal analyses due to their high diaphragm firmness, necessary lateral resistance, and translational rigidity. It's really important

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to securely resist the pressures that the loads cause. The building must also be cost-effective. Slabs are either two-way or one-way spanning systems. They are referred to as lightweight when lightweight material fills the area between the beams.

Rifat [7] the study comes to a conclusion by comparing the minimal cost variation caused by the conversion of the chosen solid and lightweight hollow block slab types. In every example that was looked at, the structure with the lightweight hollow block slabs was more expensive than the building with the solid slabs. It has been determined that structures using thin hollow block slabs were able to reach higher periods and shearing force values. It is anticipated that the structure's relative storey displacements and period will increase when the floor weight of the hollow block slab rises.

2. Materials used

1) Filler tiles
2) Cement
3) Coarse aggregate
4) M-sand
5) Reinforcement steel

3. RESULTS AND DISCUSSIONS

B. Comparison of the heat insulation properties of filler slab with conventional rcc

TABLE 1

DIGITAL THERMOMETER READINGS

Temperature	Filler slab	Rcc slab
Day 1	28°c	32°c
Day 2	27°c	31°c
Day 3	28°c	32°c

C. Design procedure of filler slab

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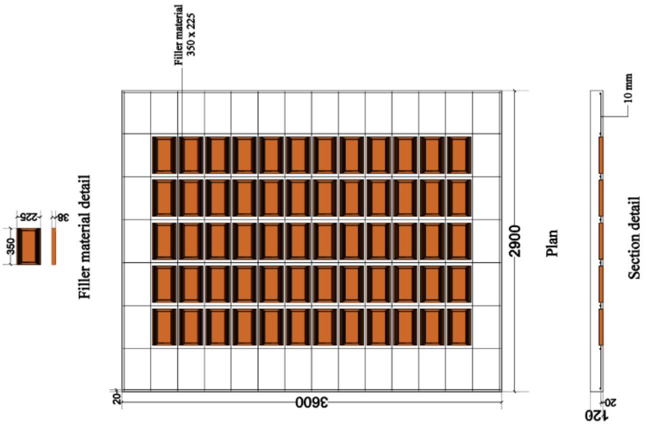

Fig. 2: AutoCad drawing of filler slab

Load calculation

self weight = 3 kn/m^2

floor finishing load = 1.0 kn/m^2

live load = 1.5 kn/m^2

total load = 5.5 kn/m^2

ultimate load = 7.3 kn/m^2

effective span= 2.7 m

maximum midspan moment = 7.5kn/m^2

diameter of the bar = 10mm

lx/d = 20

3600/20 = 20

d = 180

reduced to 120

from table 27 of is456-2000

for ly/lx = 1.228

αx = 0.084

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αx = 0.093

by interpolation

αx = 0.088

αy = 0.059

αy = 0.055

by interpolation

αy = 0.057

∴αx = 0.0885 and αy = 0.057

mux = αx·wlx^2

= 0.0885 × 7.3 × 2.7^2

= 4.709 kn/m

muy = αy·wlx^2

= 0.057 × 7.3 × 2.7^2

= 3.03 kn/m

by interpolation

αy = 0.057

mux = 0.87fyast x d(1-fyast/ fck b · d)

4.709 x 10^6 = 0.87 x 450 x ast x 120 (1-450 x ast/ 20 x 1000 x 120)

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ast = 110.81 mm^2

using 12mm φ

$\pi d^2/4$

$\pi 12^2/4$ = 102.06 mm

muy = 0.87fyast x d(1-fyast/ fck b · d)

3.03 x 10^6 = 0.87 x 450 x ast x 120 (1-450 x ast/ 20 x 1000 x 120)

ast = 70.801 mm^2

using 10mm φ

$\pi d^2/4$

$\pi 10^2/4$ = 110.93 mm

D. Site work

laying the filler tiles

1) Understanding the inner room size.
2) Arrangement of inner tiles in a required quantity.
3) Deciding the main bar and distribution bars direction with respect to the room size.
4) Proper laying of filler tiles in a way that main bars should come nearby.
5) Adjusting the tile edges with respect to the wall and using cut pieces if needed.

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Fig. 3: E.Wiring

1) It is better to prepare the electric drawings before the slab works.
2) Wiring through filler tiles.
3) Fixing the fan points and giving provision to the switchboards (on walls).
4) Providing electric conduits from each room to the distribution box through the filler tiles.

Fig.4: *F. Concrete works*

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1) Extraction of steel bars @ 14x10 inches at the adjacent of tiles.

2) Extraction of second layer steel @ 14x10 inches over the filler tiles so that steel rebar is @ 5x7 inches.

   a. Preparing of concrete, pouring and compacting.

Fig.5: Preparation of Concrete

4. CONCLUSION

1) Filler slab has shown better heat insulation than conventional RCC slab
2) The filler tile is kept below the neutral axis, the part below the neutral axis does not bear any compression so it does not make any changes.
3) We have designed a filler slab and compared to the steel area of conventional RCC and noticed that we have saved 30% of steel area.

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REFFERENCE

[1] D. R. Panchal and P. M. Marathe (2011): "Comparative Study of Conventional R.C.C & Composite Structure" JOURNAL: International Journal of Innovative Science and Research Technology2456 – 2165

[2] Suryawanshi Yogesh (2012) "Comparative Study on Analysis and Cost of R.C.C. and Steel-Composite Structure" JOURNAL: International Journal of Science and Research (IJSR) Index Copernicus Value (2013): 6.14 | Impact Factor (2015): 6.391

[3] Renavikar Aniket V (2013) "Comparative Study on Analysis and Cost of R.C.C. and Steel-Composite Structure" JOURNAL: International Journal of Science and Research (IJSR) Index Copernicus Value (2013): 6.14 | Impact Factor (2015): 6.391

[4] Shweta A. Wagh, Dr. U. P. Waghe (2014): "study of flexural behavior, thermal variation and luminosity test on filler slabs" JOURNAL: International Journal of Research in Engineering and Technology 2319-1163 (2017) 2321-7308

[5] Umesh P.Patil , Suryanarayana (2015) "Comparative Study on Analysis and Cost of R.C.C. and Steel-Composite Structure" JOURNAL: International Journal of Science and Research (IJSR) Index Copernicus Value (2013): 6.14 | Impact Factor (2015): 6.391

[6] Murat Bikçe, Bünyamin Akyol (2019) "Investigating the effect of solid and lightweight hollow block slabs on construction cost" JOURNAL: Investigating the effect of solid and lightweight hollow block slabs on construction cost 1700054

[7] Rifat Resatoglu (2019) "Investigating the effect of solid and lightweight hollow block slabs on construction cost" JOURNAL: Investigating the effect of solid and lightweight hollow block slabs on construction cost 1700054

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VERMICOMPOSTING BY VERMIREACTOR IN PACE CAMPUS

Rahil Shaffi[1], Mohammed Tanveer[1], Abbas Nihad[1], Kavyashree S.[2]

[1]Department of Civil Engineering, P. A. College of Engineering, Mangaluru, Karnataka, India.

Email: kavya.271993@gmail.com

Abstract:

The traditional method of vermicomposting has drawbacks in terms of processing time and space adaptation. By designing and building a rotary drum vermicomposter, this study attempts to overcome these difficulties. By maximizing aeration and moisture distribution, the rotary drum's creative design speeds up the decomposition process by enabling the effective mixing of waste materials. By removing the spatial limitations that are frequently connected to traditional technologies, this small and transportable vermicomposter offers a workable option for urban settings and small-scale waste generation. More people are adopting and learning about effective composting techniques due to the well-thought-out design and simple operation. The study yielded notable results, such as a notable reduction in composting time to 25-30 days as opposed to 45-60 days for standard procedures, increased space usage, and greater waste management. After the composting is done, we get vermiwash and vermicompost as the end product which can be later used for gardening or vegetation, and can also increase the fertility of the soil.

Key Words: Vermicomposting, Rotary drum vermicomposter, Aeration, Decomposition, Composting time reduction, Vermiwash.

1. Introduction

There are various ways of managing organic waste and turning it into useful fertilizer. Composting is the most widely accepted option for organic waste management due to its simplicity in producing high-quality fertilizer. Vermicomposting, the traditional method, usually takes around 45-60 days. However, the vermireactor rotary drum composting process

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can complete the organic waste decomposition process in just 25-30 days, making it an effective approach.

Jain et al.[1] The aim was to improve the efficiency of vermicomposting by modifying the conventional vermireactors. A modified vermireactor design was developed, replacing the thick vermibed at the bottom with a thick moist cloth to allow a larger quantity of organic waste to be processed. Laboratory studies were conducted to compare the performance of modified vermireactors with conventional ones.

Gajalakshmi et al. [2] The study focuses on optimizing vermireactors for epigeic earthworms (Eudriluseugeniae, Eisenia fetida, Perionyx excavatus) that dwell in humus and leaf litter in natural environments with shallow borrows. Researchers simplified the design by eliminating layers of gravel, sand, and soil typically used for other earthworm types in vermireactors. Instead, they introduced a moistened cotton cloth at the base of the vermireaction tank, providing a moisture-rich layer beneath the compost feed, resembling the natural habitat of these epigeic earthworms.

Aalok and Tripathi [3] The study aimed to assess the nutrient quality variation in compost and vermicompost derived from different plant species' leaf litters mixed with municipal solid waste (MSW) and investigate Eisenia fetida's potential in composting these litters. The experiments demonstrated substantial changes in pH, C/N ratio, and nutrient content during vermicomposting, with notable increases in total nitrogen, phosphorus, potassium, calcium, and magnesium. The earthworms showed a preference for cow dung, followed by different leaf litters mixed with MSW, indicating varied feeding efficiencies.

Das et al. [4] The study investigates the effects of various biodegradable organic wastes (BOWs), such as cattle manure, paddy straw, weeds, and municipal solid waste (MSW), used as earthworm feed in vermicomposting. Additionally, lime and microbial inoculants are introduced into the process to explore their impact on secondary nutrient status and heavy metal content in the resulting vermicompost.

Sujatha and Bhat [5] The study aims to evaluate the impact of vermicompost derived from arecanut waste on soil fertility in the context of the laterite soil ecosystem. By focusing on monitoring changes in soil fertility resulting from the application of vermicompost, the research intends to provide insights into the efficacy of organic waste recycling as a sustainable means to enhance soil fertility. This initiative aligns with the broader goal of sustainable agricultural practices

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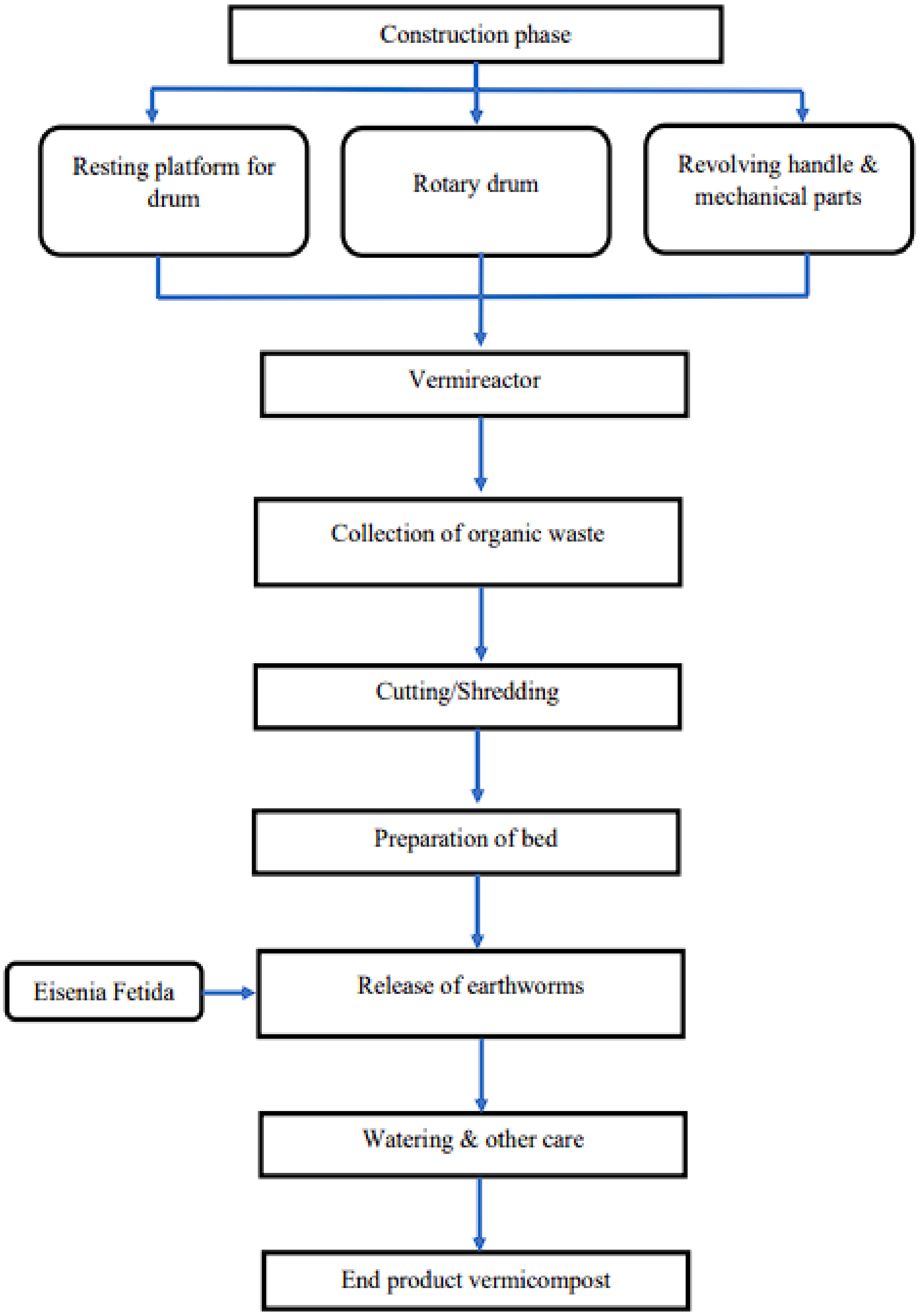
Jayakumar and Sakthivel [6] The study highlights the process of vermicomposting, a non-thermophilic and biodegradative method involving earthworms and associated microbes. This process yields vermicompost, a biofertilizer known for its finely divided, peat-like structure with exceptional qualities such as high porosity, good aeration, water holding capacity, and microbial activity. Vermicompost is rich in nutrients and possesses buffering capacity, making it conducive to soil fertility and plant growth.

2. METHODOLOGY



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2.1Materials Used

- Kitchen waste.
- Eggshell powder.
- Paper/Cardboard and other degradable waste.
- Red Soil.
- Eisenia fetida.
- Coco peat.

2.2 Process of Vermicomposting

- The Vermi reactor unit should be in a cool, moist, and shady site.
- Bio-waste from the cafeteria, college canteen, and hostel mesh are collected for preparing compost. The waste accumulated on the campus is also used like dry leaves, shredded paper waste, cardboard, etc.,
- Now prepare bedding by adding dried leaves and other biodegradable waste collected.
- The raw materials are filled till the capacity of the vermi reactor.
- Red earthworms should be released on the upper layer of the bed.
- Water should be sprinkled immediately after the release of worms.
- The Vermireactor should be turned once after every 2 days to maintain aeration and for proper decomposition.
- Proper temperature should be maintained throughout the process.
- Compost gets ready in 25-30 days.The finished product is 3/4th of the raw materials used.

2.3 Preventive Measures

- The floor of the unit should be compact to prevent earthworms' migration into the soil.
- organic wastes should be free from plastics, chemicals, pesticides, metals,etc.
- Aeration should be maintained for proper growth and multiplication of earthworms.
- Optimum moisture level (30-40 %) should be maintained.

18-25°C temperature should be maintained for proper decomposition.

2.4 WORKING WITH WORMS

Bedding - A stable habitat that serves as a hospitable environment for worms to live, feed, and grow is known as bedding. An ideal bedding material protects, provides protection, and

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moisture, and allows the flow of oxygen. The mixture of Organic waste with this bedding material accelerates decomposition.Bedding materials can easily be selected as per the local availability. Some common bedding materials include dry leaves, shredded paper, cardboard, newspaper, dust, etc. The efficient bedding should be highly porous as the soil's high porosity favors these creatures through their skin. If a worm's skin dries out, it dies.

Worm Food -Under ideal conditions, a worm can consume food excess to its body weight per day. However, the general thumb rule is that they consume approximately the amount of organic waste equivalent to their body weight per day. They eat like monsters and can eat anything organic. Most often these organic waste foods are used as worm feeds. Some commonly used worm feeds are poultry manure, cow dung, sheep and goat's manure, food scraps and peelings, leftover food, etc.

Moisture - As stated above high porosity is needed to maintain healthy conditions for worms and to maintain high porosity adequate moisture needs to be maintained in the system. Worms are much active in moist soil as compared to dry ones but most of the species of worms are found unable to survive flooding, hence an optimum moisture content of almost 50 to 75 percent must be maintained for proper functioning and survival of worms. Available literature suggests that in Indian conditions moisture range of 50 to 60 percent serves every purpose of vermicomposting operations in any system. We are taking this optimum range of moisture for the installation of a vermicompost system on the premises.

Aeration - Worms are oxygen breathers and are unable to survive in the absence of oxygen. Hence high moisture combined with poor aeration can cause sudden multiple deaths of worms. Proper oxygen is maintained inside the unit with manual turning from shovels or trowels.

Temperature - All the species of worms exhibit high growth rates but E. eugenia has a wider endurance for temperature in comparison to the other two species which allows the species to often survive at 45 degrees Celsius and as low as 5 degrees Celsius. Besides these the depth of the wastes cannot exceed 30 cm. due to temperature Harms during the initial thermophilic stage of decomposition.

pH - Worms prefer to inhabit under neutral conditions for which the optimum range of pH is 7 to 8. Worms are sensitive to the nature of their surrounding medium. If the pH falls below 6 the worms migrate or are killed.Under these conditions, pH can be adjusted by adding calcium carbonate if it needs to increase but if it needs to lower the pH acidic bedding can be used.

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Light - Earthworms are very sensitive to light and they tend to avoid the strong light that's why worms come to the surface only at night i.e., to avoid the light. They detect the light by photoreceptor cells on their skin these cells can trigger pain when exposed to sunlight.

Therefore, it is necessary to cover the worms from waste and to prevent daylight, several techniques can also be used such as the use of dark heavy curtains, or the system can be covered by banana and palm leaves.

Daily Vermicomposting Routine

- Spray approximately 1 kg of water onto the compost mix daily to maintain proper moisture levels.
- Rotate the drum every 2-3 days initially, performing 3-5 rotations per session, and adjust the frequency based on the composting process's progress.

3. DESIGN OF ROTARY DRUM VERMICOMPOSTER

3.1 Materials Required

- Large plastic barrel or drum with a tight-fitting lid (120ltrs capacity)
- Drill
- 1/4-inch drill bit
- 1-inch drill bit
- 2-3 feet of PVC pipe
- PVC end cap
- Worms (Eisenia fetida)
- Bedding materials (shredded newspaper, cardboard, leaves, cocopeat)
- Organic food scraps (vegetable and fruit scraps, eggshells)
- Rectangular hollow tube
- Screws and bolts

3.2 Rotary Drum Vermicomposter

- The drum volume is 55 liters. This is the main component of vermicomposting where the organic material is composted. It rotates slowly to mix the compost and distribute the organic waste evenly.
- The frame is made of a steel rectangular tube section the steel should be such that it should

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stand the load of the drum and compost inside it.

- It is designed such that it can be rotated freely 360°. There is also an axial inside the drum so that it can withstand the load of the compost and bedding. Rotation is provided so that the waste that is dumped inside can be mixed thoroughly without using our hands and to maintain aerobic composting and ventilation.
- Holes are provided on the top and side of the drum for circulation and proper ventilation and to insure adequate oxygen supply for the worms.
- Hatches are provided in the U-shaped and they are secured using hardware for opening and closing. The hatch is provided so that the waste can be dumped inside the barrel using these hatches.
- For the rotation of the device handle lever is provided so that the perfect mixture of the waste can be obtained. The lever is provided for easy workability.

3.2.1 Assembly of Rotary Drum Vermicomposter

- Clean the drum thoroughly to remove any residue or chemicals.
- Cut the drum lengthwise with a saw into two halves.
- Drill holes along the bottom edge of both halves of the drum, spaced about 1 inch apart.
- Cut the rod or pipe into two pieces, each slightly longer than the width of the drum.
- Drill two holes through each end of the rods.
- Place the rods through the holes in the drum.
- Secure the rods to the drum halves with nuts and bolts.
- Cut two circles from the mesh, slightly larger than the diameter of the drum.
- Attach the mesh circles to the inside of each drum half, covering the holes drilled. This will prevent compost from falling out.
- Attach hinges and a latch to one of the drum halves to create a door that can be opened and closed.

3.3 MATERIALS FOR COMPOSTING

Waste Papers -Shredded paper is an inexpensive and readily available bedding material. It is also easy to shred and provides a good balance of carbon and nitrogen in the compost.

Coconut coir (coco peat) - Coconut coir is a sustainable alternative to peat moss and provides good aeration and moisture retention. It is also pH-neutral and can be reused multiple times.

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Cardboard **-** Cardboard is a good source of carbon and can be shredded or torn into small pieces to use as bedding. It is also a good way to recycle cardboard waste.

Leaves: - Leaves are a readily available source of carbon and can be used as bedding. It is important to avoid using leaves from trees that have been treated with pesticides or herbicides.

Shredded paper - Shredded paper is an excellent bedding material as it is readily available, easy to shred, and provides a good balance of carbon and nitrogen in the compost. It is important to avoid using glossy or colored paper, as these can contain harmful chemicals.

Vegetable and fruit peels - Vegetables and fruit peels are good sources of nutrients for the worms and can also be used as bedding material. However, it is important to avoid using citrus peels as they are too acidic and can harm the worms.

3.4 Bedding procedure

- Start by shredding or tearing the bedding material into small pieces. This will help increasesurface area and promote composting.
- If using materials like straw or hay, make sure to remove any seeds or plant matter that could attract pests.
- Mix the bedding materials to achieve a good balance of carbon and nitrogen. As a general rule, aim for a ratio of about 3:1 carbon to nitrogen.
- Continue alternating layers of bedding material and waste until the vermicomposter is full. Moisten the bedding material with water to ensure that it is moist but not too wet. The bedding material should feel like a damp sponge.
- Keep the bedding moist for a couple of days, so that the materials start to decompose a little bit.
- Introduce the worms into the bin and let them settle inside the bin.
- Add a layer of food waste on top of the bedding material. Be careful not to add too much food waste at once, as this can lead to anaerobic conditions and unpleasant odors.
- Close the vermicomposter and begin rotating it regularly to ensure good aeration and mixing of the compost.
- Check the moisture level of the compost regularly and add more water as needed. You may also need to add more bedding material if the compost becomes too wet or if the worms

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start to run out of bedding.

- Harvest the compost once it is fully broken down and has a dark, earthy smell. This can take anywhere from afew weeks to a few months, depending on the size of the vermicomposter and the amount of food waste added.

3.5 EGGSHELL POWDER IN VERMICOMPOST

Eggshells are a great source of calcium and can help balance the pH of vermicompost. Adding eggshell powder to your vermicompost can provide essential nutrients to your plants and help maintain a neutral pH environment for worms. To use eggshell powder, rinse the eggshells, crush them into small pieces, and add a small amount to your vermicompost. Monitor the pH regularly and adjust the amount of eggshell powder as needed.

3.6 VERMIWASH AS A BY-PRODUCT

Vermiwash is a liquid extract obtained from vermicomposting, which is a process of composting organic waste using earthworms. It is an excellent organic fertilizer and biopesticide and is rich in nutrients and beneficial microorganisms.

3.7 pH TEST ON VERMIWASH

The pH value of vermiwash, which is a liquid fertilizer produced from earthworm castings, ideally falls within the slightly acidic to neutral range, typically between 6.5 and 7.5. This pH range is conducive to nutrient availability and microbial activity, promoting healthy plant growth. However, slight variations may occur depending on factors such as the composition of the feedstock and the process of vermicomposting.

Fig. 1: Vermiwash

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3.8 FINAL PRODUCT AS VERMICOMPOST

Vermicompost is a type of organic fertilizer and soil conditioner that is rich in nutrients. It is produced as earthworms consume organic waste and turn it into smaller particles. During this process, the waste is enriched with beneficial microorganisms and essential nutrients like nitrogen, phosphorus, potassium, calcium, and magnesium. Vermicompost is collected from the earthworm's excretions as castings.

Fig. 2: Final product of vermicompost

3.9 SEPARATION OF VERMICULTURE AND VERMICOMPOST

Lose the bed with the help of mesh, and sieve and wait for 5-10 minutes or till earthworms reach to lower layers, then, remove a layer free from earthworms and their eggs. Repeat this process of separation three times and collect the removed material (vermicompost) sieve it and keeping for further use. The material remaining in the bed will be vermiculture. Collect it and keep it for its survival in a vermiculture bed.

4. CONCLUSION

The rotary drum vermireactor efficiently composts materials, yielding the final product in 28 days, faster than conventional methods. The laboratory test results show consistent increases in vermicast production in both low-rate and high-rate reactors with the new design. Vermiwash, a valuable byproduct, has been confirmed to be a nutrient-rich liquid fertilizer. The vermicompost produced is nutrient-rich and surpasses many commercial fertilizers.

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REFERENCE

[1] Jain K, Singh J, Gupta S.K, Development of a modified vermireactor for efficient vermicomposting: a laboratory study. Bioresource Technology, Volume 90, Issue 3, December 2003, pp: 229-352.

[2] Gajalakshmi S, Sankar Ganesh P, Abbas S.A, A highly cost-effective simplification in the design of fast-paced vermireactors based on epigeic earthworms. Biochemical Engineering Journal, Volume 22, Issue 2, January 2005, pp: 111-116.

[3] Tasneem Abbasi, Gajalakshmi S, Towards modeling and design of vermicomposting systems: Mechanisms of composting/vermicomposting and their implications. Indian Journal of Biotechnology, Volume 8, April 2009, pp: 177-182.

[4] Asha Alok, Ashutosh Kumar Tripathi, Composting-Vermicomposting of Different Types of Leaves using Earthworm Species Eisenia fetida. Dynamic Soil, Dynamic Plant, Volume 4, 2010, pp: 139-144.

[5] Debrabata Das, Pradip Bhattacharya, Ghosh B.C and Pabitra Banik, Effect of vermicomposting on calcium, sulfur and some heavy metal content of different biodegradable organic wastes under liming and microbial inoculation. Journal of Environmental Science and Health, Part B, 2012, pp: 205-211.

[6] Sujatha S and Ravi Bhat, Impacts of Vermicompost and Nitrogen, Phosphorus, and Potassium Application on Soil Fertility Status in Arecanut Grown on a Laterite Soil. Communication in soil and Soil Science and Plant Analysis, Volume 43, 2012, pp: 2400-2412.

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